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Boutique et al.

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[54] **NONAQUEOUS DETERGENT COMPOSITIONS CONTAINING BLEACH PRECURSORS**

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[52] **U.S. Cl.** **510/376**; 510/338; 510/369; 510/418

[58] **Field of Search** 510/376, 369, 510/338, 418

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,900,469	2/1990	Farr et al.	252/96
4,929,380	5/1990	Schulz et al.	252/121

FOREIGN PATENT DOCUMENTS

0 339 995 A2	11/1989	European Pat. Off.	C11D 3/39
0 565 017 A2	10/1993	European Pat. Off.	C11D 3/39
WO 92/02610	2/1992	WIPO	C11D 17/00
WO 96/10073	4/1996	WIPO	C11D 17/00
WO 97/00937	1/1997	WIPO	C11D 17/00

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[57] **ABSTRACT**

Disclosed is a nonaqueous liquid detergent composition comprising a bleach precursor, said composition having an average particle size of the bleach precursor of less than 600 microns

11 Claims, No Drawings

NONAQUEOUS DETERGENT COMPOSITIONS CONTAINING BLEACH PRECURSORS

REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional application Ser. No. 60/020,822 filed Jun. 28, 1996.

FIELD OF THE INVENTION

This invention relates to liquid laundry detergent products which are nonaqueous in nature and which contain bleach precursors having reduced average particle size.

BACKGROUND OF THE INVENTION

Liquid nonaqueous detergents are well known in the art. This class of detergents is particularly interesting for enhancing the chemical compatibility of detergent composition components, in particular bleach precursors and bleach sources.

In such nonaqueous products, these bleaching precursors are less reactive than if they had been dissolved in the liquid aqueous matrix.

One of the drawbacks of bleach precursors may be their low dissolution rate in the wash liquor. As a result, the perhydrolysis rate is reduced which in turn affects the cleaning performance. This problem is even more acute with the move in consumer washing habits towards lower temperature and shorter washcycle. Problems can also, in particular, be encountered when the said bleach precursors are used under high hardness conditions, resulting upon dissolution in the formation of calcium salts of low solubility. Such a problem of reduced perhydrolysis is further increased where the bleach precursor is present as certain divalent and/or trivalent metal salt as such a form exhibits a very low rate of dissolution, thus affecting the perhydrolysis rate.

A further problem, associated with the use of bleach precursors having slow perhydrolysis rates, appears when soiled fabrics release a catalase enzyme in the washing liquor. Hence, due to the slow perhydrolysis of the precursor, the catalase will destroy the hydrogen peroxide component before the bleach activator is properly perhydrolysed. As a result, the concentration of peracid present in the wash is reduced and so is the bleaching performance.

Another problem associated with the use of bleach precursors is that there is a tendency for such products to phase separate as dispersed insoluble solid particulate material drops from suspension and settles at the bottom of the container holding the liquid detergent product. Phase stabilizers such as thickeners or viscosity control agents can be added to such products to enhance the physical stability thereof. Such materials, however, can add cost and bulk to the product without contributing to the laundering/cleaning performance of such detergent compositions.

A further problem associated with bleach precursors is that it has been observed that bleach precursors can induce visual inhomogenities in the final product. This represents a problem as composition aesthetics is a key element in terms of consumer acceptance.

Accordingly, the formulator of a nonaqueous liquid detergent composition is faced with the challenge of formulating a physically stable non-aqueous detergent composition which provides effective dissolution of the precursor in order to result in an efficient perhydrolysis.

The Applicant has now surprisingly found that bleach precursor particles of reduced size within a liquid nonaqueous detergent composition do meet the above objectives.

It is therefore an advantage of the invention to provide bleach precursors containing non-aqueous liquid-detergent compositions which produce efficient rate of dissolution, which are physically stable and which have improved visual appearance.

It is a further advantage of the invention to provide compositions with improved resistance to a catalase enzyme.

It is another advantage of the invention to provide compositions which enable the use of a lower amount of peroxygen bleach.

EP 0 541 610 discloses the preparation of nonaqueous liquid detergents containing more than 8% anionic surfactants by wet grinding of a mixture comprising a peroxygen bleach. The average particle size obtained after grinding is in the preferred range of 1–5 microns. This document does not disclose or suggest that utilizing bleach precursor particles of reduced particle sizes does provide the benefit of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to a liquid nonaqueous detergent composition comprising a bleach precursor characterized in that the average particle size of said bleach percursor is less than 600 microns.

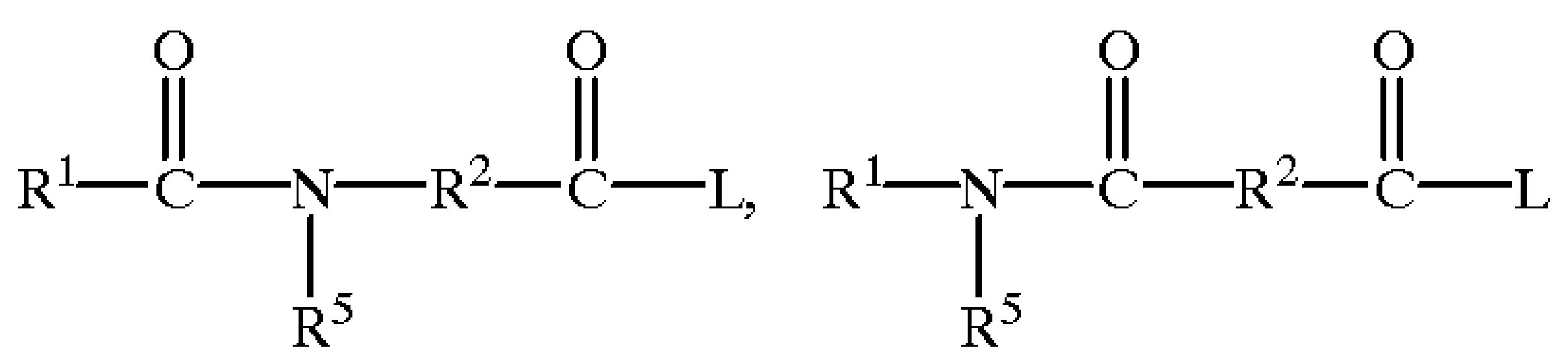
DETAILED DESCRIPTION OF THE INVENTION

1. Bleach Activators

The bleach activators suitable for the present invention are the anionic bleach activators described in the literature, such as in the GB Patents 836,988; 864,798; 907,356; 1,003,310 and 1,519,351; German Patent 3,337,921; EP-A-0185522; EP-A-0174132; EP-A-0120591; and U.S. Pat. Nos. 1,246,339; 3,332,882; 4,128,494; 4,412,934 and 4,675,393.

A class of anionic bleach activators is that as disclosed in U.S. Pat. Nos. 4,751,015 and 4,397,757, in EP-A-284292, EP-A-331,229 and EP-A-03520. Examples of anionic peroxyacid bleach activators include sodium-4-benzoyloxy benzene sulphonate; sodium-l-methyl-2-benzoyloxy benzene-4-sulphonate; sodium nonanoyloxybenzene sulphonate; sodium 3,5,5,-trimethyl hexanoyloxybenzene sulphonate.

Bleach activators also useful in the present invention are amide substituted compounds of the general formulas:

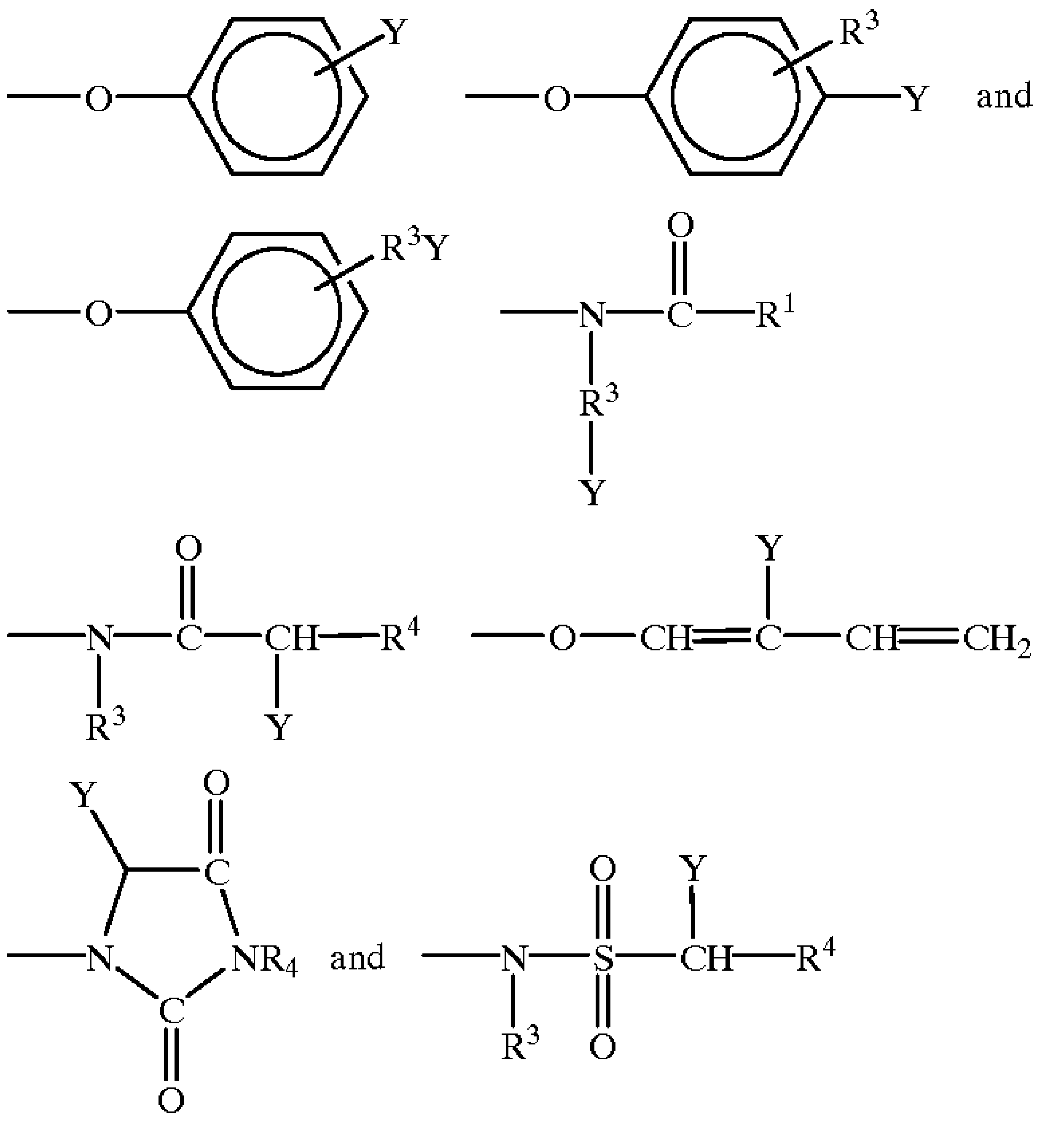


$$R^1-\overset{O}{\overset{\|}{C}}-\underset{R^5}{\underset{|}{N}}-R^2-\overset{O}{\overset{\|}{C}}-L, \quad R^1-\underset{R^5}{\underset{|}{N}}-\overset{O}{\overset{\|}{C}}-R^2-\overset{O}{\overset{\|}{C}}-L$$

or mixtures thereof, wherein R^1 is an alkyl, aryl, or alkaryl group containing from about 1 to about 14 carbon atoms, R^2 is an alkylene, arylene or alkarylene group containing from about 1 to about 14 carbon atoms, R^5 is H or an alkyl, aryl, or alkaryl group containing from about 1 to about 10 carbon atoms, and L can be essentially any suitable leaving group. A leaving group is any group that is displaced from the bleaching activator as a consequence of the nucleophilic attack on the bleach activator by the perhydroxide anion. This, the perhydrolysis reaction, results in the formation of the peroxycarboxylic acid. Generally, for a group to be a suitable leaving group it must exert an electron attracting effect. It should also form a stable entity so that the rate of the back reaction is negligible. This facilitates the nucleophilic attack by the perhydroxide anion.

The L group must be sufficiently reactive for the reaction to occur within the optimum time frame (e.g., a wash cycle) . However, if L is too reactive, this activator will be difficult to stabilize for use in a bleaching composition. These characteristics are generally paralleled by the pKa of the conjugate acid of the leaving group, although exceptions to this convention are known. Ordinarily, leaving groups that exhibit such behavior are those in which their conjugate acid has a pKa in the range of from about 4 to about 13, preferably from about 6 to about 11 and most preferably from about 8 to about 11.

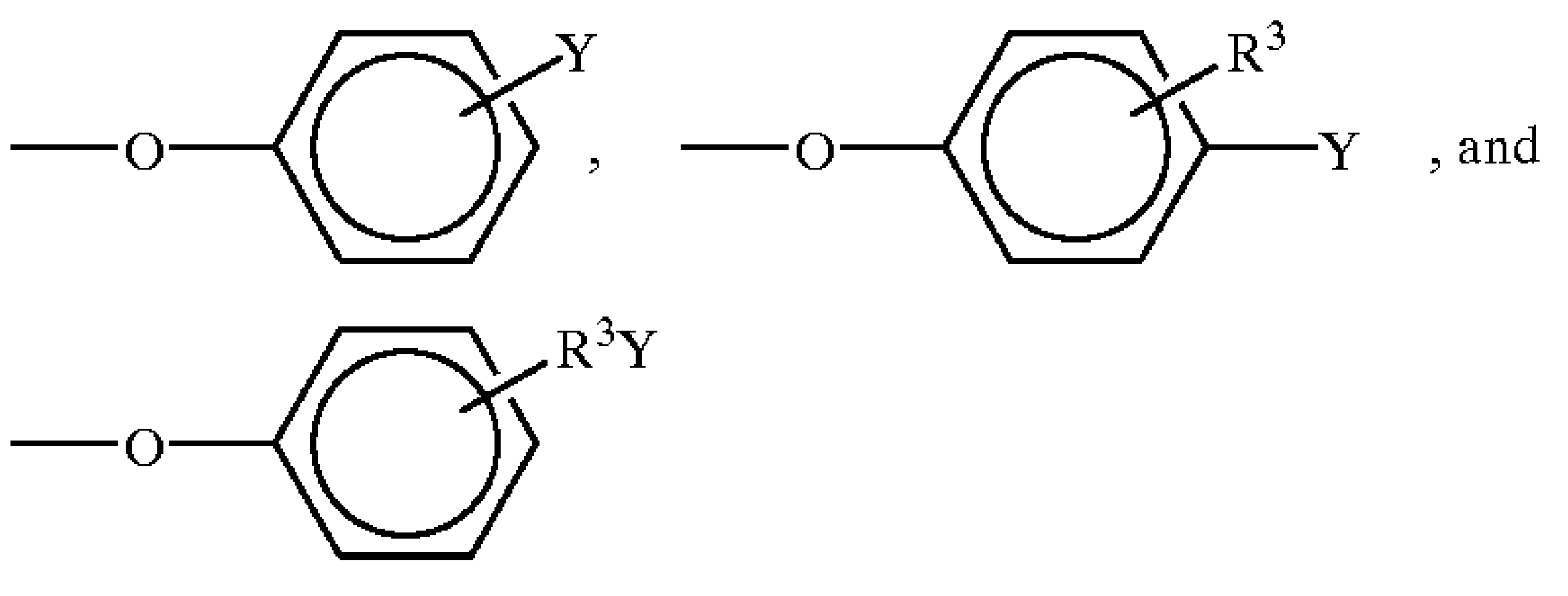
Preferred bleach activators are those of the above general formula wherein R^1, R^2 and R^5 are as defined for the peroxyacid and L is selected from the group consisting of:



and mixtures thereof, wherein R^1 is an alkyl, aryl, or alkaryl group containing from about 1 to about 14 carbon atoms, R^3 is an alkyl chain containing from 1 to about 8 carbon atoms, R^4 is H or R^3, and Y is a solubilizing anionic group.

The solubizing groups are $—SO_3^-$, $—CO_2^-$, $—SO_4^-$, and most preferably $—SO_3^-$ and $—CO_2^-$ wherein R^3 is an alkyl chain container from about 1 to about 4 carbon atoms.

Preferred anionic bleach activators are those of the above general formula wherein L is selected from the group consisting of:



wherein R^3 is as defined above and Y is $—SO_3^-$ or $—CO_2^-$.

Preferred examples of bleach activators of the above formulae include 4-[N-octanoyl-6-aminohexanoyloxy] benzene sulfonate, 4-[N-nonanoyl-6-aminohexanoyloxy] benzene sulfonate, 4-[N-decanoyl-6-aminohexanoyloxy] benzene sulfonate and mixtures thereof. Said activators are described in U.S. Pat. No. 4,634,551 and U.S. Pat. No. 4,852,989.

Another important class of anionic bleach activators provide organic peracids as described herein by ring-opening as a consequence of the nucleophilic attack on the carbonyl carbon of the cyclic ring by the perhydroxide anion. For instance, this ring-opening reaction in certain activators involves attack at the lactam ring carbonyl by hydrogen peroxide or its anion. Since attack of an acyl lactam by hydrogen peroxide or its anion occurs preferably at the exocyclic carbonyl, obtaining a significant fraction of ring-opening may require a catalyst. Another example of ring-opening bleach activators can be found in other activators, such as those disclosed in U.S. Pat. No. 4,966,723, Hodge et al, issued Oct. 30, 1990.

Preferred bleach activators according to the present invention are present as a monovalent, a divalent and/or trivalent metal salt. The bleach activator salt can be added as a powder dispersed in the non-aqueous base. The bleach activator salt can also be premixed with a liquid non-aqueous ingredient such as a nonionic surfactant, organic solvent and/or mixtures thereof. The bleach activator salts can be obtained by any method known to prepare divalent metal salts of anionic surface active solutions.

The bleach activator salts of the present invention can comprise mixed salts whereby at least one of the salts is a divalent or trivalent salt. The mixed salts are obtained by cocrystallization of the bleach activator salts. The mixed salts can comprise a monovalent salt. Examples of these salts are Na_3Mg [4-(N-nonanoyl-6-aminohexanoyl)oxy benzene sulfonate 5.

Preferred salts according to the present invention are Na, Ca, Mg and Al salts. Highly preferred are Na, Ca and Mg salts or mixtures thereof.

The bleach precursor according to the present invention is characterized by having a reduced average particle size less than 600 microns, preferably between 50 and 500 microns, most preferred between 100 and 400 microns. Stated particle sizes are the diameters of particles of equal volume. Particle sizes can be measured, for example, using Coulter counters or laser particle size measuring equipment such as that sold under the Malvern name. The bleach precursors are prepared by grinding in a mill which will break down the particles to diameters below 500 microns. The bleach precursor salt will generally be supplied as much larger particles of above about 600 microns diameter. If desired, the bleach precursor salt may be premixed with other solids (e.g. builders, enzymes). Preferred mills are colloid mills.

Surprisingly, it has now been found that the bleach activators of reduced particle size, are physically and chemically stable in the concentrate, while at the same time being more effective as a bleach species in the wash liquor.

In addition, it has been found that said bleach activators, when agglomerated with certain acids such as citric acid, are more chemically stable.

The present invention also relates to a process for the production of a nonaqueous liquid detergent having the composition and properties described above. In this process, the liquid constituents are thoroughly mixed in a first mixing step and the suspension obtained is subjected to wet grinding so that the average particle diameter of the solid constituents in the suspension obtained after grinding is 5–200 microns. In a second process step, the bleach precursor particles are mixed with the ground suspension from the first mixing step in a second mixing step. This mixture is then subjected to wet grinding so that the average particle size of the bleach precursor is less than 600 microns, preferably between 50 and 500 microns, most preferred between 100 and 400 microns. Other compounds, such as bleach compounds are then added to the resulting mixture.

Hydrogen Peroxide Sources

Preferred sources of hydrogen peroxide include perhydrate bleaches. The perhydrate is typically an inorganic perhydrate bleach, normally in the form of the sodium salt, as the source of alkaline hydrogen peroxide in the wash liquor. This perhydrate is normally incorporated at a level of from 0.1% to 60%, preferably from 3% to 40% by weight, more preferably from 5% to 35% by weight and most preferably from 8% to 30% by weight of the composition.

The perhydrate may be any of the alkalimetal inorganic salts such as perborate monohydrate or tetrahydrate, percarbonate, perphosphate and persilicate salts but is conventionally an alkali metal perborate or percarbonate.

Sodium percarbonate, which is the preferred perhydrate, is an addition compound having a formula corresponding to 2Na2CO3.3H2O2, and is available commercially as a crystalline solid. Most commercially available material includes a low level of a heavy metal sequestrant such as EDTA, 1-hydroxyethylidene 1, 1-diphosphonic acid (HEDP) or an amino-phosphonate, that is incorporated during the manufacturing process. For the purposes of the detergent composition aspect of the present invention, the percarbonate can be incorporated into detergent compositions without additional protection, but preferred executions of such compositions utilise a coated form of the material. A variety of coatings can be used including borate, boric acid and citrate or sodium silicate of SiO2:Na2O ratio from 1.6:1 to 3.4:1, preferably 2.8:1, applied as an aqueous solution to give a level of from 2% to 10%, (normally from 3% to 5%) of silicate solids by weight of the percarbonate. However the most preferred coating is a mixture of sodium carbonate and sulphate or sodium chloride.

The nonaqueous detergent compositions of this invention may further comprise a surfactant- and low-polarity solvent-containing liquid gel phase having dispersed therein the bleach activator salt. The components of the liquid and solid phases of the detergent compositions herein, as well as composition form, preparation and use, are described in greater detail as follows: All concentrations and ratios are on a weight basis unless otherwise specified.

Surfactant

The amount of the surfactant mixture component of the detergent compositions herein can vary depending upon the nature and amount of other composition components and depending upon the desired rheological properties of the ultimately formed composition. Generally, this surfactant mixture will be used in an amount comprising from about 10% to 90% by weight of the composition. More preferably, the surfactant mixture will comprise from about 15% to 50% by weight of the composition.

A typical listing of anionic, nonionic, ampholytic and zwitterionic classes, and species of these surfactants, is given in U.S. Pat. No. 3,664,961 issued to Norris on May 23, 1972.

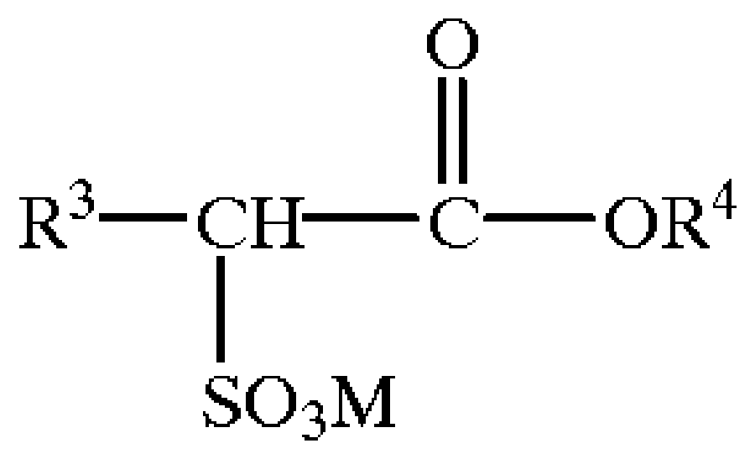
Highly anionic preferred surfactants are the linear alkyl benzene sulfonate (LAS) materials. Such surfactants and their preparation are described for example in U.S. Pat. Nos. 2,220,099 and 2,477,383, incorporated herein by reference. Especially preferred are the sodium and potassium linear straight chain alkylbenzene sulfonates in which the average number of carbon atoms in the alkyl group is from about 11 to 14. Sodium C_{11}–C_{14}, e.g., C_{12}, LAS is especially preferred.

Preferred anionic surfactants include the alkyl sulfate surfactants hereof are water soluble salts or acids of the formula $ROSO_3M$ wherein R preferably is a C_{10}–C_{24} hydrocarbyl, preferably an alkyl or hydroxyalkyl having a C_{10}–C_{18} alkyl component, more preferably a C_{12}–C_{15} alkyl or hydroxyalkyl, and M is H or a cation, e.g., an alkali metal cation (e.g. sodium, potassium, lithium), or ammonium or substituted ammonium (quaternary ammonium cations such as tetramethyl-ammonium and dimethyl piperdinium cations).

Other suitable anionic surfactants include alkyl alkoxylated sulfate surfactants hereof are water soluble salts or acids of the formula RO(A)$_m$SO3M wherein R is an unsubstituted C_{10}–C_{24} alkyl or hydroxyalkyl group having a C_{10}–C_{24} alkyl component, preferably a C_{12}–C_{18} alkyl or hydroxyalkyl, more preferably C_{12}–C_{15} alkyl or hydroxyalkyl, A is an ethoxy or propoxy unit, m is greater than zero, typically between about 0.5 and about 6, more preferably between about 0.5 and about 3, and M is H or a cation which can be, for example, a metal cation (e.g., sodium, potassium, lithium, calcium, magnesium, etc.), ammonium or substituted-ammonium cation. Alkyl ethoxylated sulfates as well as alkyl propoxylated sulfates are contemplated herein. Specific examples of substituted ammonium cations include quaternary ammonium cations such as tetramethyl-ammonium and dimethyl piperdinium cations Exemplary surfactants are C_{12}–C_{15} alkyl polyethoxylate (1.0) sulfate (C_{12}–C_{15}E(1.0)M), C_{12}–C_{15} alkyl polyethoxylate (2.25) sulfate (C_{12}–C_{15}E(2.25)M), C_{12}–C_{15} alkyl polyethoxylate (3.0) sulfate (C_{12}–C_{15}E(3.0)M), and C_{12}–C_{15} alkyl polyethoxylate (4.0) sulfate (C_{12}–C_{15}E(4.0) M), wherein M is conveniently selected from sodium and potassium.

Other suitable anionic surfactants to be used are alkyl ester sulfonate surfactants including linear esters of C_8–C_{20} carboxylic acids (i.e., fatty acids) which are sulfonated with gaseous SO_3 according to "The Journal of the American Oil Chemists Society", 52 (1975), pp. 323–329. Suitable starting materials would include natural fatty substances as derived from tallow, palm oil, etc.

The preferred alkyl ester sulfonate surfactant, especially for laundry applications, comprise alkyl ester sulfonate surfactants of the structural formula:



$$R^3-\underset{\underset{SO_3M}{|}}{CH}-\overset{\overset{O}{\|}}{C}-OR^4$$

wherein R^3 is a C_8–C_{20} hydrocarbyl, preferably an alkyl, or combination thereof, R^4 is a C_1–C_6 hydrocarbyl, preferably an alkyl, or combination thereof, and M is a cation which forms a water soluble salt with the alkyl ester sulfonate. Suitable salt-forming cations include metals such as sodium, potassium, and lithium, and substituted or unsubstituted ammonium cations. Preferably, R^3 is C_{10}–C_{16} alkyl, and R4 is methyl, ethyl or isopropyl. Especially preferred are the methyl ester sulfonates wherein R^3 is C_{10}–C_{16} alkyl.

Other anionic surfactants useful for detersive purposes can also be included in the laundry detergent compositions of the present invention. These can include salts (including, for example, sodium, potassium, ammonium, and substituted ammonium salts such as mono-, di- and triethanolamine salts) of soap, C_9–C_{20} linear alkylbenzenesulfonates, C_8–C_{22} primary of secondary alkanesulfonates, C_8–C_{24} olefinsulfonates, sulfonated polycarboxylic acids prepared by sulfonation of the pyrolyzed product of alkaline earth metal citrates, e.g., as described in British patent specification No. 1,082,179, C_8–C_{24} alkylpolyglycolethersulfates (containing up to 10 moles of ethylene oxide); alkyl glycerol sulfonates, fatty acyl glycerol sulfonates, fatty oleyl glycerol sulfates, alkyl phenol ethylene oxide ether sulfates, paraffin sulfonates, alkyl phosphates, isethionates such as the acyl isethionates, N-acyl taurates, alkyl succinamates and sulfosuccinates, monoesters of sulfosuccinates (especially saturated and unsaturated C_{12}–C_{18} monoesters) and diesters of sulfosuccinates (especially saturated and unsaturated C_6–C_{12} diesters), sulfates of alkylpolysaccharides such as the sulfates of alkylpolyglucoside (the nonionic nonsulfated compounds being described below), and alkyl polyethoxy carboxylates such as those of the formula $RO(CH_2CH_2O)_k$—CH_2COO—M+ wherein R is a C_8–C_{22} alkyl, k is an integer from 1 to 10, and M is a soluble salt-forming cation. Resin acids and hydrogenated resin acids are also suitable, such as rosin, hydrogenated rosin, and resin acids and hydrogenated resin acids present in or derived from tall oil. Further examples are described in "Surface Active Agents and Detergents" (Vol. I and II by Schwartz, Perry and Berch). A variety of such surfactants are also generally disclosed in U.S. Pat. No. 3,929,678, issued Dec. 30, 1975 to Laughlin, et al. at Column 23, line 58 through Column 29, line 23 (herein incorporated by reference).

When included therein, the detergent compositions of the present invention typically comprise from about 1% to about 40%, preferably from about 5% to about 25% by weight of such anionic surfactants.

One class of nonionic surfactants useful in the present invention are condensates of ethylene oxide with a hydrophobic moiety to provide a surfactant having an average hydrophilic-lipophilic balance (HLB) in the range from 8 to 17, preferably from 9.5 to 14, more preferably from 12 to 14. The hydrophobic (lipophilic) moiety may be aliphatic or aromatic in nature and the length of the polyoxyethylene group which is condensed with any particular hydrophobic group can be readily adjusted to yield a water-soluble compound having the desired degree of balance between hydrophilic and hydrophobic elements.

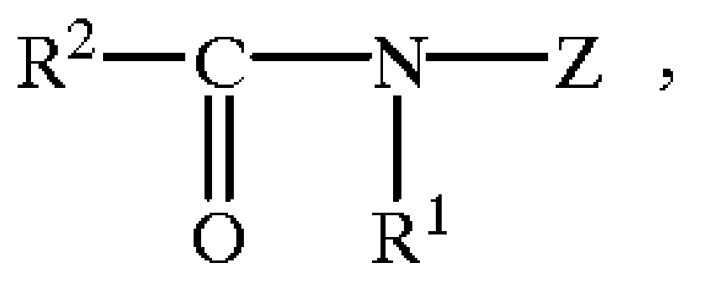
Especially preferred nonionic surfactants of this type are the C_9–C_{15} primary alcohol ethoxylates containing 3–12 moles of ethylene oxide per mole of alcohol, particularly the C_{12}–C_{15} primary alcohols containing 5–8 moles of ethylene oxide per mole of alcohol.

Another class of nonionic surfactants comprises alkyl polyglucoside compounds of general formula

$$RO(C_nH_{2n}O)_tZ_x$$

wherein Z is a moiety derived from glucose; R is a saturated hydrophobic alkyl group that contains from 12 to 18 carbon atoms; t is from 0 to 10 and n is 2 or 3; x is from 1.3 to 4, the compounds including less than 10% unreacted fatty alcohol and less than 50% short chain alkyl polyglucosides. Compounds of this type and their use in detergent are disclosed in EP-B 0 070 077, 0 075 996 and 0 094 118.

Also suitable as nonionic surfactants are poly hydroxy fatty acid amide surfactants of the formula



$$R^2—\underset{\underset{O}{\|}}{C}—\underset{\underset{R^1}{|}}{N}—Z\ ,$$

wherein R^1 is H, or R^1 is C_{1-4} hydrocarbyl, 2-hydroxy ethyl, 2-hydroxy propyl or a mixture thereof, R^2 is C_{5-31} hydrocarbyl, and Z is a polyhydroxyhydrocarbyl having a linear hydrocarbyl chain with at least 3 hydroxyls directly connected to the chain, or an alkoxylated derivative thereof. Preferably, R^1 is methyl, R^2 is a straight C_{11-15} alkyl or alkenyl chain such as coconut alkyl or mixtures thereof, and Z is derived from a reducing sugar such as glucose, fructose, maltose, lactose, in a reductive amination reaction.

Nonaqueous Liquid Diluent

To form the liquid phase of the detergent compositions, the hereinbefore described surfactant (mixture) may be combined with a nonaqueous liquid diluent such as a liquid alcohol alkoxylate material or a nonaqueous, low-polarity organic solvent.

Alcohol Alkoxylates

One component of the liquid diluent suitable to form the compositions herein comprises an alkoxylated fatty alcohol material. Such materials are themselves also nonionic surfactants. Such materials correspond to the general formula:

$$R^1(C_mH_{2m}O)_nOH$$

wherein R^1 is a C_8–C_{16} alkyl group, m is from 2 to 4, and n ranges from about 2 to 12. Preferably R^1 is an alkyl group, which may be primary or secondary, that contains from about 9 to 15 carbon atoms, more preferably from about 10 to 14 carbon atoms. Preferably also the alkoxylated fatty alcohols will be ethoxylated materials that contain from about 2 to 12 ethylene oxide moieties per molecule, more preferably from about 3 to 10 ethylene oxide moieties per molecule.

The alkoxylated fatty alcohol component of the liquid diluent will frequently have a hydrophilic-lipophilic balance (HLB) which ranges from about 3 to 17. More preferably, the HLB of this material will range from about 6 to 15, most preferably from about 8 to 15.

Examples of fatty alcohol alkoxylates useful as one of the essential components of the nonaqueous liquid diluent in the compositions herein will include those which are made from alcohols of 12 to 15 carbon atoms and which contain about 7 moles of ethylene oxide. Such materials have been commercially marketed under the trade names Neodol 25-7 and Neodol 23-6.5 by Shell Chemical Company. Other useful Neodols include Neodol 1-5, an ethoxylated fatty alcohol averaging 11 carbon atoms in its alkyl chain with about 5 moles of ethylene oxide; Neodol 23-9, an ethoxylated primary C_{12}–C_{13} alcohol having about 9 moles of ethylene oxide and Neodol 91-10, an ethoxylated C_9–C_{11}, primary alcohol having about 10 moles of ethylene oxide. Alcohol ethoxylates of this type have also been marketed by Shell Chemical Company under the Dobanol tradename. Dobanol 91-5 is an ethoxylated C_9–C_{11} fatty alcohol with an average of 5 moles ethylene oxide and Dobanol 25-7 is an ethoxylated C_{12}–C_{15} fatty alcohol with an average of 7 moles of ethylene oxide per mole of fatty alcohol.

Other examples of suitable ethoxylated alcohols include Tergitol 15-S-7 and Tergitol 15-S-9 both of which are linear secondary alcohol ethoxylates that have been commercially marketed by Union Carbide Corporation. The former is a mixed ethoxylation product of C_{11} to C_{15} linear secondary alkanol with 7 moles of ethylene oxide and the latter is a similar product but with 9 moles of ethylene oxide being reacted.

Other types of alcohol ethoxylates useful in the present compositions are higher molecular weight nonionics, such as Neodol 45-11, which are similar ethylene oxide condensation products of higher fatty alcohols, with the higher fatty alcohol being of 14–15 carbon atoms and the number of ethylene oxide groups per mole being about 11. Such products have also been commercially marketed by Shell Chemical Company.

The alcohol alkoxylate component when utilized as part of the liquid diluent in the nonaqueous compositions herein will generally be present to the extent of from about 1% to 60% by weight of the composition. More preferably, the alcohol alkoxylate component will comprise about 5% to

40% by weight of the compositions herein. Most preferably, the alcohol alkoxylate component will comprise from about 10% to 25% by weight of the detergent compositions herein.

Nonaqueous Low-Polarity Organic Solvent

Another component of the liquid diluent which may form part of the detergent compositions herein comprises nonaqueous, low-polarity organic solvent(s). The term "solvent" is used herein to connote the non-surface active carrier or diluent portion of the liquid phase of the composition. While some of the essential and/or optional components of the compositions herein may actually dissolve in the "solvent"-containing phase, other components will be present as particulate material dispersed within the "solvent"-containing phase. Thus the term "solvent" is not meant to require that the solvent material be capable of actually dissolving all of the detergent composition components added thereto.

The nonaqueous organic materials which are employed as solvents herein are those which are liquids of low polarity. For purposes of this invention, "low-polarity" liquids are those which have little, if any, tendency to dissolve one of the preferred types of particulate material used in the compositions herein, i.e., the peroxygen bleaching agents, sodium perborate or sodium percarbonate. Thus relatively polar solvents such as ethanol should not be utilized. Suitable types of low-polarity solvents useful in the nonaqueous liquid detergent compositions herein do include alkylene glycol mono lower alkyl ethers, lower molecular weight polyethylene glycols, lower molecular weight methyl esters and amides, and the like.

A preferred type of nonaqueous, low-polarity solvent for use herein comprises the mono-, di-, tri-, or tetra-C_2–C_3 alkylene glycol mono C_2–C_6 alkyl ethers. The specific examples of such compounds include diethylene glycol monobutyl ether, tetraethylene glycol monobutyl ether, dipropolyene glycol monoethyl ether, and dipropylene glycol monobutyl ether. Diethylene glycol monobutyl ether and dipropylene glycol monobutyl ether are especially preferred. Compounds of the type have been commercially marketed under the tradenames Dowanol, Carbitol, and Cellosolve.

Another preferred type of nonaqueous, low-polarity organic solvent useful herein comprises the lower molecular weight polyethylene glycols (PEGs) . Such materials are those having molecular weights of at least about 150. PEGs of molecular weight ranging from about 200 to 600 are most preferred.

Yet another preferred type of non-polar, nonaqueous solvent comprises lower molecular weight methyl esters. Such materials are those of the general formula: R^1—C(O)—OCH_3 wherein R^1 ranges from 1 to about 18. Examples of suitable lower molecular weight methyl esters include methyl acetate, methyl propionate, methyl octanoate, and methyl dodecanoate.

The nonaqueous, low-polarity organic solvent(s) employed should, of course, be compatible and non-reactive with other composition components, e.g., bleach and/or activators, used in the liquid detergent compositions herein. Such a solvent component will generally be utilized in an amount of from about 1% to 60% by weight of the composition. More preferably, the nonaqueous, low-polarity organic solvent will comprise from about 5% to 40% by weight of the composition, most preferably from about 10% to 25% by weight of the composition.

Liquid Diluent Concentration

As with the concentration of the surfactant mixture, the amount of total liquid diluent in the compositions herein will be determined by the type and amounts of other composition components and by the desired composition properties. Generally, the liquid diluent will comprise from about 20% to 95% by weight of the compositions herein. More preferably, the liquid diluent will comprise from about 50% to 70% by weight of the composition.

SOLID PHASE

The nonaqueous detergent compositions herein may further comprise a solid phase of particulate material which is dispersed and suspended within the liquid phase. Generally such particulate material will range in size from about 0.1 to 1500 microns. More preferably such material will range in size from about 5 to 500 microns.

The particulate material utilized herein can comprise one or more types of detergent composition components which in particulate form are substantially insoluble in the nonaqueous liquid phase of the composition. The types of particulate materials which can be utilized are described in detail as follows:

Surfactants

A type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein includes ancillary anionic surfactants which are fully or partially insoluble in the nonaqueous liquid phase. The most common type of anionic surfactant with such solubility properties comprises primary or secondary alkyl sulfate anionic surfactants. Such surfactants are those produced by the sulfation of higher C_8–C_{20} fatty alcohols.

Conventional primary alkyl sulfate surfactants have the general formula

$$ROSO_3^-M^+$$

wherein R is typically a linear C_8–C_{20} hydrocarbyl group, which may be straight chain or branched chain, and M is a water-solubilizing cation. Preferably R is a C_{10}–C_{14} alkyl, and M is alkali metal. Most preferably R is about C_{12} and M is sodium.

Conventional secondary alkyl sulfates may also be utilized as the essential anionic surfactant component of the solid phase of the compositions herein. Conventional secondary alkyl sulfate surfactants are those materials which have the sulfate moiety distributed randomly along the hydrocarbyl "backbone" of the molecule. Such materials may be depicted by the structure

$$CH_3(CH_2)_n(CHOSO_3^-M^+)\ (CH_2)_mCH_3$$

wherein m and n are integers of 2 or greater and the sum of m+n is typically about 9 to 15, and M is a water-solubilizing cation.

If utilized as all or part of the requisite particulate material, ancillary anionic surfactants such as alkyl sulfates will generally comprise from about 1% to 10% by weight of the composition, more preferably from about 1% to 5% by weight of the composition. Alkyl sulfate used as all or part of the particulate material is prepared and added to the compositions herein separately from the unalkoxylated alkyl sulfate material which may form part of the alkyl ether sulfate surfactant component essentially utilized as part of the liquid phase herein.

Organic Builder Material

Another possible type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein comprises an organic detergent builder material which serves to counteract the effects of calcium, or other ion, water hardness encountered during laundering/

bleaching use of the compositions herein. Examples of such materials include the alkali metal, citrates, succinates, malonates, fatty acids, carboxymethyl succinates, carboxylates, polycarboxylates and polyacetyl carboxylates. Specific examples include sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids and citric acid. Other examples of organic phosphonate type sequestering agents such as those which have been sold by Monsanto under the Dequest tradename and alkanehydroxy phosphonates. Citrate salts are highly preferred.

Other suitable organic builders include the higher molecular weight polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic acid copolymers and their salts, such as those sold by BASF under the Sokalan trademark.

Another suitable type of organic builder comprises the water-soluble salts of higher fatty acids, i.e., "soaps". These include alkali metal soaps such as the sodium, potassium, ammonium, and alkylolammonium salts of higher fatty acids containing from about 8 to about 24 carbon atoms, and preferably from about 12 to about 18 carbon atoms. Soaps can be made by direct saponification of fats and oils or by the neutralization of free fatty acids. Particularly useful are the sodium and potassium salts of the mixtures of fatty acids derived from coconut oil and tallow, i.e., sodium or potassium tallow and coconut soap.

If utilized as all or part of the requisite particulate material, insoluble organic detergent builders can generally comprise from about 1% to 20% by weight of the compositions herein. More preferably, such builder material can comprise from about 4% to 10% by weight of the composition.

Inorganic Alkalinity Sources

Another possible type of particulate material which can be suspended in the nonaqueous liquid detergent compositions herein can comprise a material which serves to render aqueous washing solutions formed from such compositions generally alkaline in nature. Such materials may or may not also act as detergent builders, i.e., as materials which counteract the adverse effect of water hardness on detergency performance.

Examples of suitable alkalinity sources include water-soluble alkali metal carbonates, bicarbonates, borates, silicates and metasilicates. Although not preferred for ecological reasons, water-soluble phosphate salts may also be utilized as alkalinity sources. These include alkali metal pyrophosphates, orthophosphates, polyphosphates and phosphonates. Of all of these alkalinity sources, alkali metal carbonates such as sodium carbonate are the most preferred.

The alkalinity source, if in the form of a hydratable salt, may also serve as a desiccant in the nonaqueous liquid detergent compositions herein. The presence of an alkalinity source which is also a desiccant may provide benefits in terms of chemically stabilizing those composition components such as the peroxygen bleaching agent which may be susceptible to deactivation by water.

If utilized as all or part of the particulate material component, the alkalinity source will generally comprise from about 1% to 15% by weight of the compositions herein. More preferably, the alkalinity source can comprise from about 2% to 10% by weight of the composition. Such materials, while water-soluble, will generally be insoluble in the nonaqueous detergent compositions herein. Thus such materials will generally be dispersed in the nonaqueous liquid phase in the form of discrete particles.

OPTIONAL COMPOSITION COMPONENTS

In addition to the composition liquid and solid phase components as hereinbefore described, the detergent compositions herein can, and preferably will, contain various optional components. Such optional components may be in either liquid or solid form. The optional components may either dissolve in the liquid phase or may be dispersed within the liquid phase in the form of fine particles or droplets. Some of the materials which may optionally be utilized in the compositions herein are described in greater detail as follows:

Optional Inorganic Detergent Builders

The detergent compositions herein may also optionally contain one or more types of inorganic detergent builders beyond those listed hereinbefore that also function as alkalinity sources. Such optional inorganic builders can include, for example, aluminosilicates such as zeolites. Aluminosilicate zeolites, and their use as detergent builders are more fully discussed in Corkill et al., U.S. Pat. No. 4,605,509; Issued Aug. 12, 1986, the disclosure of which is incorporated herein by reference. Also crystalline layered silicates, such as those discussed in this '509 U.S. patent, are also suitable for use in the detergent compositions herein. If utilized, optional inorganic detergent builders can comprise from about 2% to 15% by weight of the compositions herein.

Optional Enzymes

The detergent compositions herein may also optionally contain one or more types of detergent enzymes. Such enzymes can include proteases, amylases, cellulases and lipases. Such materials are known in the art and are commercially available. They may be incorporated into the nonaqueous liquid detergent compositions herein in the form of suspensions, "marumes" or "prills". Another suitable type of enzyme comprises those in the form of slurries of enzymes in nonionic surfactants. Enzymes in this form have been commercially marketed, for example, by Novo Nordisk under the tradename "LDP."

Enzymes added to the compositions herein in the form of conventional enzyme prills are especially preferred for use herein. Such prills will generally range in size from about 100 to 1,000 microns, more preferably from about 200 to 800 microns and will be suspended throughout the nonaqueous liquid phase of the composition. Prills in the compositions of the present invention have been found, in comparison with other enzyme forms, to exhibit especially desirable enzyme stability in terms of retention of enzymatic activity over time. Thus, compositions which utilize enzyme prills need not contain conventional enzyme stabilizing such as must frequently be used when enzymes are incorporated into aqueous liquid detergents.

If employed, enzymes will normally be incorporated into the nonaqueous liquid compositions herein at levels sufficient to provide up to about 10 mg by weight, more typically from about 0.01 mg to about 5 mg, of active enzyme per gram of the composition. Stated otherwise, the nonaqueous liquid detergent compositions herein will typically comprise from about 0.001% to 5%, preferably from about 0.01% to 1% by weight, of a commercial enzyme preparation. Protease enzymes, for example, are usually present in such commercial preparations at levels sufficient to provide from 0.005 to 0.1 Anson units (AU) of activity per gram of composition.

Optional Chelating Agents

The detergent compositions herein may also optionally contain a chelating agent which serves to chelate metal ions, e.g., iron and/or manganese, within the nonaqueous detergent compositions herein. Such chelating agents thus serve to form complexes with metal impurities in the composition which would otherwise tend to deactivate composition components such as the peroxygen bleaching agent. Useful chelating agents can include amino carboxylates, phosphonates, amino phosphonates, polyfunctionally-substituted aromatic chelating agents and mixtures thereof.

Amino carboxylates useful as optional chelating agents include ethylenediaminetetraacetates, N-hydroxyethyl-ethylene-diaminetriacetates, nitrilotriacetates, ethylenediamine tetrapropionates, triethylenetetraaminehexacetates, diethylenetriaminepentaacetates, ethylenediaminedisuccinates and ethanoldiglycines. The alkali metal salts of these materials are preferred.

Amino phosphonates are also suitable for use as chelating agents in the compositions of this invention when at least low levels of total phosphorus are permitted in detergent compositions, and include ethylenediaminetetrakis (methylene-phosphonates) as DEQUEST. Preferably, these amino phosphonates do not contain alkyl or alkenyl groups with more than about 6 carbon atoms.

Preferred chelating agents include hydroxyethyl-diphosphonic acid (HEDP), diethylene triamine penta acetic acid (DTPA), ethylenediamine disuccinic acid (EDDS) and dipicolinic acid (DPA) and salts thereof. The chelating agent may, of course, also act as a detergent builder during use of the compositions herein for fabric laundering/bleaching. The chelating agent, if employed, can comprise from about 0.1% to 4% by weight of the compositions herein. More preferably, the chelating agent will comprise from about 0.2% to 2% by weight of the detergent compositions herein.

Optional Thickening, Viscosity Control and/or Dispersing Agents

The detergent compositions herein may also optionally contain a polymeric material which serves to enhance the ability of the composition to maintain its solid particulate components in suspension. Such materials may thus act as thickeners, viscosity control agents and/or dispersing agents. Such materials are frequently polymeric polycarboxylates but can include other polymeric materials such as polyvinylpyrrolidone (PVP) and polymeric amine derivatives such as quaternized, ethoxylated hexamethylene diamines.

Polymeric polycarboxylate materials can be prepared by polymerizing or copolymerizing suitable unsaturated monomers, preferably in their acid form. Unsaturated monomeric acids that can be polymerized to form suitable polymeric polycarboxylates include acrylic acid, maleic acid (or maleic anhydride), fumaric acid, itaconic acid, aconitic acid, mesaconic acid, citraconic acid and methylenemalonic acid. The presence in the polymeric polycarboxylates herein of monomeric segments, containing no carboxylate radicals such as vinylmethyl ether, styrene, ethylene, etc. is suitable provided that such segments do not constitute more than about 40% by weight of the polymer.

Particularly suitable polymeric polycarboxylates can be derived from acrylic acid. Such acrylic acid-based polymers which are useful herein are the water-soluble salts of polymerized acrylic acid. The average molecular weight of such polymers in the acid form preferably ranges from about 2,000 to 10,000, more preferably from about 4,000 to 7,000, and most preferably from about 4,000 to 5,000. Water-soluble salts of such acrylic acid polymers can include, for example, the alkali metal, salts. Soluble polymers of this type are known materials. Use of polyacrylates of this type in detergent compositions has been disclosed, for example, Diehl, U.S. Pat. No. 3,308,067, issued Mar. 7, 1967. Such materials may also perform a builder function.

If utilized, the optional thickening, viscosity control and/or dispersing agents should be present in the compositions herein to the extent of from about 0.1% to 4% by weight. More preferably, such materials can comprise from about 0.5% to 2% by weight of the detergents compositions herein.

Optional Brighteners, Suds Suppressors and/or Perfumes

The detergent compositions herein may also optionally contain conventional brighteners, suds suppressors, silicone oils, bleach catalysts, and/or perfume materials. Such brighteners, suds suppressors, silicone oils, bleach catalysts, and perfumes must, of course, be compatible and non-reactive with the other composition components in a non-aqueous environment. If present, brighteners suds suppressors and/or perfumes will typically comprise from about 0.01% to 2% by weight of the compositions herein.

Suitable bleach catalysts include the manganese based complexes disclosed in U.S. Pat. No. 5,246,621, U.S. Pat. No. 5,244,594, U.S. Pat. No. 5,114,606 and U.S. Pat. No. 5,114,611.

COMPOSITION FORM

The particulate-containing liquid detergent compositions of this invention are substantially nonaqueous (or anhydrous) in character. While very small amounts of water may be incorporated into such compositions as an impurity in the essential or optional components, the amount of water should in no event exceed about 5% by weight of the compositions herein. More preferably, water content of the nonaqueous detergent compositions herein will comprise less than about 1% by weight.

The particulate-containing nonaqueous detergent compositions herein will be in the form of a liquid.

COMPOSITION PREPARATION AND USE

The non-aqueous liquid detergent compositions herein can be prepared by first forming the surfactant-containing non-aqueous liquid phase and by thereafter adding to this phase the additional particulate components in any convenient order and by mixing, e.g., agitating, the resulting component combination to form the phase stable compositions herein. In a typical process for preparing such compositions, essential and certain preferred optional components will be combined in a particular order and under certain conditions.

In a first step of a preferred preparation process, the anionic surfactant-containing powder used to form the surfactant-containing liquid phase is prepared. This pre-preparation step involves the formation of an aqueous slurry containing from 40% to 50% of one or more alkali metal salts of linear C_{10-16} alkyl benzene sulfonic acid and from 3% to 15% of one or more diluent non-surfactant salts. In a subsequent step, this slurry is dried to the extent necessary to form a solid material containing less than 5% by weight of residual water.

After preparation of this solid anionic surfactant-containing material, this material can be combined with one or more of the non-aqueous organic solvents to form the surfactant-containing liquid phase of the detergent compositions herein. This is done by reducing the anionic surfactant-containing material formed in the previously described pre-preparation step to powdered form and by combining such powdered material with an agitated liquid medium comprising one or more of the non-aqueous organic solvents, either surfactant or non-surfactant or both, as hereinbefore described. This combination is carried out under agitation conditions which are sufficient to form a thoroughly mixed dispersion of the LAS/salt material throughout a non-aqueous organic liquid.

In a subsequent processing step, the non-aqueous liquid dispersion so prepared can then be subjected to milling or high shear agitation under conditions which are sufficient to provide the structured, surfactant-containing liquid phase of the detergent compositions herein. Such milling or high shear agitation conditions will generally include maintenance of a temperature between 20° C. and 50° C. Milling and high shear agitation of this combination will generally provide an increase in the yield value of the structured liquid phase to within the range of from 1 Pa to 5 Pa.

After formation of the dispersion of LAS/salt co-dried material in the non-aqueous liquid, either before or after such dispersion is milled or agitated to increase its yield value, the additional particulate material to be used in the detergent compositions herein can be added. Such components which can be added under high shear agitation include any optional surfactant particles, particles of substantially all of an organic builder, e.g., citrate and/or fatty acid, and/or an alkalinity source, e.g., sodium carbonate, can be added while continuing to maintain this admixture of composition components under shear agitation. Agitation of the mixture is continued, and if necessary, can be increased at this point to form a uniform dispersion of insoluble solid phase particulates within the liquid phase.

In a second process step, the bleach precursor particles are mixed with the ground suspension from the first mixing step in a second mixing step. This mixture is then subjected to wet grinding so that the average particle size of the bleach precursor is less than 600 microns, preferably between 50 and 500 microns, most preferred between 100 and 400 microns. Other compounds, such as bleach compounds are then added to the resulting mixture.

After some or all of the foregoing solid materials have been added to this agitated mixture, the particles of the highly preferred peroxygen bleaching agent can be added to the composition, again while the mixture is maintained under shear agitation. By adding the peroxygen bleaching agent material last, or after all or most of the other components, and especially after alkalinity source particles, have been added, desirable stability benefits for the peroxygen bleach can be realized. If enzyme prills are incorporated, they are preferably added to the non-aqueous liquid matrix last.

As a final process step, after addition of all of the particulate material, agitation of the mixture is continued for a period of time sufficient to form compositions having the requisite viscosity, yield value and phase stability characteristics. Frequently this will involve agitation for a period of from about 1 to 30 minutes.

In adding solid components to non-aqueous liquids in accordance with the foregoing procedure, it is advantageous to maintain the free, unbound moisture content of these solid materials below certain limits. Free moisture in such solid materials is frequently present at levels of 0.8% or greater. By reducing free moisture content, e.g., by fluid bed drying, of solid particulate materials to a free moisture level of 0.5% or lower prior to their incorporation into the detergent composition matrix, significant stability advantages for the resulting composition can be realized.

The compositions of this invention, prepared as hereinbefore described, can be used to form aqueous washing solutions for use in the laundering and bleaching of fabrics. Generally, an effective amount of such compositions is added to water, preferably in a conventional fabric laundering automatic washing machine, to form such aqueous laundering/bleaching solutions. The aqueous washing/bleaching solution so formed is then contacted, preferably under agitation, with the fabrics to be laundered and bleached therewith.

An effective amount of the liquid detergent compositions herein added to water to form aqueous laundering/bleaching solutions can comprise amounts sufficient to form from about 500 to 7,000 ppm of composition in aqueous solution. More preferably, from about 800 to 5,000 ppm of the detergent compositions herein will be provided in aqueous washing/bleaching solution.

The following examples illustrate the preparation and performance advantages of non-aqueous liquid detergent compositions of the instant invention. Such examples, however, are not necessarily meant to limit or otherwise define the scope of the invention herein.

EXAMPLE I

Preparation of Non-Aqueous Liquid Detergent Composition

1) Butoxy-propoxy-propanol (BPP) and a $C_{12-16}EO(5)$ ethoxylated alcohol nonionic surfactant (Genapol 24/50) are mixed for a short time (1–5 minutes) using a blade impeller in a mix tank into a single phase.
2) NaLAS is added to the BPP/Genapol solution in the mix tank to partially dissolve the NaLAS. Mix time is approximately one hour. The tank is blanketed with nitrogen to prevent moisture pickup from the air.
3) If needed, liquid base (LAS/BPP/NI) is pumped out into drums. Molecular sieves (type 3A, 4–8 mesh) are added to each drum at 10% of the net weight of the liquid base. The molecular sieves are mixed into the liquid base using both single blade turbine mixers and drum rolling techniques. The mixing is done under nitrogen blanket to prevent moisture pickup from the air. Total mix time is 2 hours, after which 0.1–0.4% of the moisture in the liquid base is removed. Molecular sieves are removed by passing the liquid base through a 20–30 mesh screen. Liquid base is returned to the mix tank.
4) Additional solid ingredients are prepared for addition to the composition. Such solid ingredients include the following:

Sodium carbonate (particle size 100 microns)
Sodium citrate anhydrous
Maleic-acrylic copolymer (BASF Sokolan)
Brightener (Tinopal PLC)
Tetra sodium salt of hydroxyethylidene diphosphonic acid (HEDP)
Sodium diethylene triamine penta methylene phosphonate

These solid materials, which are all millable, are added to the mix tank and mixed with the liquid base until smooth. This approximately 1 hour after addition of the last powder. The tank is blanketed with nitrogen after addition of the powders. No particular order of addition for these powders is critical.

6) The batch is pumped once through a Fryma colloid mill, which is a simple rotor-stator configuration in which a high-speed rotor spins inside a stator which creates a zone of high shear. This partially reduces the particle size of all of the solids. This leads to an increase in yield value (i.e. structure). The batch is then recharged to the mix tank after cooling.

7) The bleach precursor particles are mixed with the ground suspension from the first mixing step in a second mixing step. This mixture is then subjected to wet grinding so that the average particle size of the bleach precursor is less than 600 microns, preferably between 50 and 500 microns, most preferred between 100 and 400 microns.

8) Other solid materials could be added after this first step. These include the following:

Sodium percarbonate (400–600 microns)

Protease, cellulase and amylase enzyme prills (400–800 microns)

Titanium dioxide particles (5 microns)

These non-millable solid materials are then added to the mix tank followed by liquid ingredients (perfume and silicone-based suds suppressor). The batch is then mixed for one hour (under nitrogen blanket). The resulting composition has the formula set forth in Table I.

TABLE I

Non-Aqueous Liquid Detergent Composition with Bleach

Component	Wt % Active
LAS Na salt	21.7
C12-16E0 = 5 alcohol ethoxylate	18.98
BPP	18.98
Sodium citrate	1.42
[4-[N-nonanoyl-6-aminohexanoyloxy] benzene sulfonate] Na salt (65% a.m.)	7.34
DiEthyleneTriamine-PentaMethylenePhosphonate Na salt	0.90
Chloride salt of methyl quaternized polyethoxylated hexamethylene diamine	0.95
Sodium Carbonate	3
Maleic-acrylic copolymer	3.32
HEDP Na salt	0.90
Protease Prills	0.40
Amyiase Prills	0.84
Sodium Percarbonate	18.89
Suds Suppressor	0.35
Perfume	0.46
Titanium Dioxide	0.5
Brightener	0.14
Miscellaneous upto	100.00%

The resulting Table I composition is a stable, anhydrous heavy-duty liquid laundry detergent which provides excellent stain and soil removal performance when used in normal fabric laundering operations.

A bleach-containing nonaqueous laundry detergent is prepared having the composition as set forth in Table II.

TABLE II

Component	Example 1 Wt. %	Example 2
Liquid Base		
Sodium Linear alkyl benzene sulfonate	20	20
C_{12-14}, EO = 5 alcohol ethoxylate	20	20
N-Butoxy propoxy propanol (BPP)	20	20
Perfume	1	1
Solids		
Trisodium Citrate	1.5	1.5
Sodium percarbonate	20	15
Sodium carbonate	5	10
Diethylene Triamine Pentamethylene Phosphonate Na salt	1	1
Hydroxyethyl diphosphonate (HEDP)Na salt	1.5	1.5
[4-[N-nonanoyl-6-aminohexanoyloxy] benzene sulfonate] Na salt average particle size < 600 microns	5	5
Brightener	0.2	0.2
TiO_2	0.5	0.5
Enzymes and minor	up to 100%	

The above compositions are stable anhydrous liquid laundry detergents wherein the bleach activator is stable in the concentrate and wherein the bleach activator is effective in the wash liquor.

What is claimed is:

1. A nonaqueous liquid detergent composition comprising a bleach precursor, wherein the average particle size of the bleach precursor is less than 600 microns, and wherein the bleach precursor is present as a salt selected from the group consisting of a divalent metal salt, a trivalent metal salt, a mixed metal salt comprising a divalent or a trivalent metal salt, and mixtures thereof.

2. A nonaqueous detergent composition according to claim **1**, wherein said salt is selected from Ca and/or Mg.

3. A nonaqueous detergent composition according to claim **2**, wherein the mixed metal salt comprises a monovalent metal.

4. A nonaqueous detergent composition according to claim **1**, wherein the bleach activator is 4-benzoyloxy benzene sulphonate; 1-methyl-2-benzoyloxy benzene-4-sulphonate; nonanoyloxybenzene sulphonate; 3,5,5,-trimethyl hexanoyloxybenzene sulphonate.

5. A nonaqueous detergent composition according to claim **1**, wherein the bleach activator is 4-[N-octanoyl-6-aminohexanoyloxy]benzene sulfonate, 4-[N-nonanoyl-6-aminohexanoyloxy]benzene sulfonate, 4-(N-decanoyl-6-aminohexanoyloxy]benzene sulfonate and mixtures thereof.

6. A nonaqueous detergent composition according to claim **1**, further comprising a bleaching agent selected from percarbonate and/or perborate.

7. A process for preparing a nonaqueous detergent composition

a) a first step whereby solid surfactant-containing and liquid nonaqueous organic solvent constituents are mixed in a first mixing step and the suspension obtained is subjected to wet grinding so that the average particle diameter of the solid constituents in the suspension obtained after grinding is 5–200 microns.

b) a second process step whereby bleach precursor particles, selected from the group consisting of a divalent metal salt, a trivalent metal salt, a mixed metal salt comprising a divalent or trivalent metal salt, and mixtures thereof, are mixed with the ground suspension from the first mixing step in a second mixing step, said mixture being subjected to wet grinding so that the average particle size of the bleach precursor is less than 600 microns.

8. A nonaqueous liquid detergent composition according to claim **1** comprising a bleach precursor wherein the average particle size of the bleach precursor is between 50 and 500 microns.

9. A nonaqueous liquid detergent composition according to claim **8** comprising a bleach precursor wherein the average particle size of the bleach precursor is between 100 and 400 microns.

10. A process according to claim **2** for preparing a nonaqueous detergent composition

a) a first step whereby the liquid constituents are mixed in a first mixing step and the suspension obtained is subjected to wet grinding so that the average particle diameter of the solid constituents in the suspension obtained after grinding is 5–200 microns.

b) a second process step whereby the bleach precursor particles are mixed with the ground suspension from the first mixing step in a second mixing step, said mixture being subjected to wet grinding so that the average particle size of the bleach precursor is between 50 and 500 microns.

11. A process according to claim **10** for preparing a nonaqueous detergent composition

a) a first step whereby the liquid constituents are mixed in a first mixing step and the suspension obtained is subjected to wet grinding so that the average particle diameter of the solid constituents in the suspension obtained after grinding is 5–200 microns.

b) a second process step whereby the bleach precursor particles are mixed with the ground suspension from the first mixing step in a second mixing step, said mixture being subjected to wet grinding so that the average particle size of the bleach precursor is between 100 and 400 microns.

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